iscellaneous Publication No. 900

SOIL and WATER CONSERVATION RESEARCH in the Pacific Coast Region

gricultural Research Service—U.S. Department of Agriculture

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THE CONSERVATION TEAM . . .

Soil and water are the Nation's two most vital natural resources. The orderly development and the conservation of these resources depend on the efforts and interests of many groups. Collectively, they are called the Soil and Water Conservation Team. This team includes farmers, ranchers, Soil Conservation District personnel, technicians, teachers, extension workers, economists, and research workers.

THE ROLE OF RESEARCH . . .

An effective soil and water conservation program must be based on sound technical information. Research has provided this pool of knowledge. Practices now being applied reflect the results gleaned from many years' experience.

But we need to know more. Our expanding population and the consequent demands for more food and fiber have created new problems in the management and use of soil and water. Facts gained from today's research will provide the bases for conserving tomorrow's soil and water.

THIS PUBLICATION describes a few examples of recent soil and water conservation research. Scientists and engineers of the Soil and Water Conservation Research Division, Agricultural Research Service, have cooperated with the personnel of the State agricultural experiment stations in developing the research that is in progress.

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SOIL AND WATER CONSERVATION RESEARCH in the PACIFIC COAST REGION

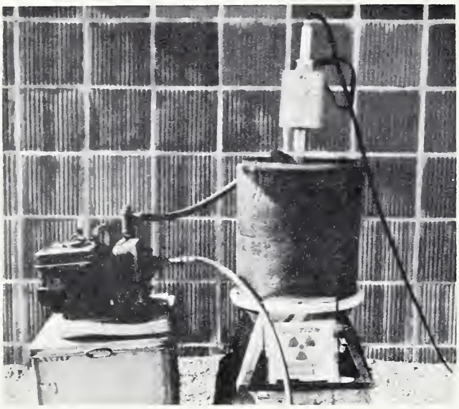
By the Soil and Water Conservation Research Division

Agricultural Research Service

Soil and water research in the Pacific coast area is especially concerned with soil moisture and water entry in soils. Much of the rainfall and the water applied for irrigation evaporates from the soils. In places, water moves upward from ground water tables and evaporates at the soil surface; soils then become salinized. In other places sodic soils need to be reclaimed by leaching with high-salt water.

Existing irrigation and drainage systems need to be redesigned or operated more efficiently. Ground water studies are essential: To understand the processes of recharging reservoirs and wells; to facilitate recharging in order to have sufficient water during dry periods; and to locate areas for recharging when there is excess water.

Fertilizer studies are continuing in order that a proper balance is obtained between plant food and water use.



A relatively new instrument--the neutron scattering moisture meter--is used extensively to measure soil moisture. Here, the neutron probe is being calibrated before it is used to determine the moisture content of a soil down to the water table. Fresno, Calif.

BN-15195

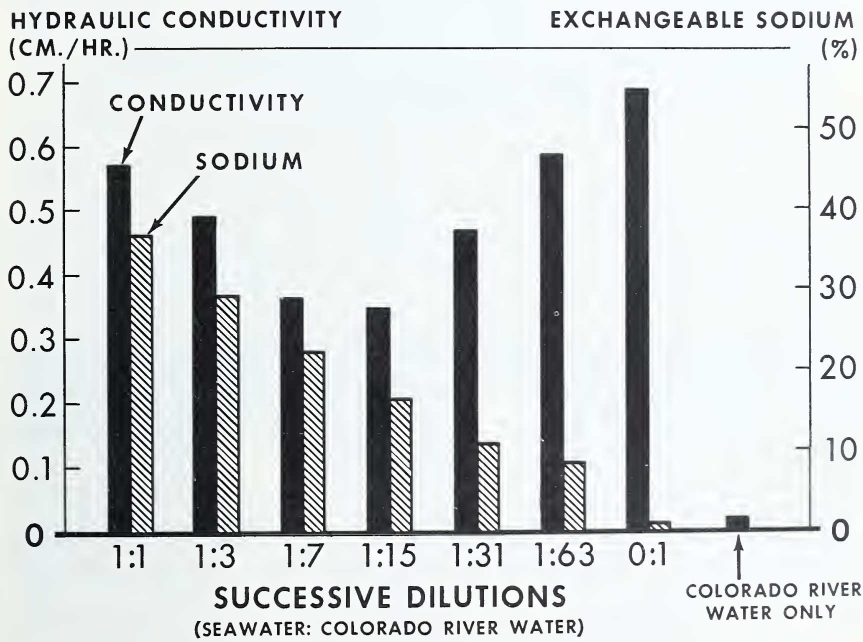
The technician is taking measurements of soil moisture with the neutron scattering moisture meter, near Lompoc, Calif. The scaler (or recorder) is on the platform in front of the operator. The lead shield (foreground, left center) protects the operator from radiation emitted from the probe. The probe is lowered into an access tube that was previously installed to a depth of 20 feet. The cart allows easy transfer of the instrument from one experimental site to the next.

BN-15194

RECLAIMING SODIC SOILS WITH HIGH-SALT WATERS

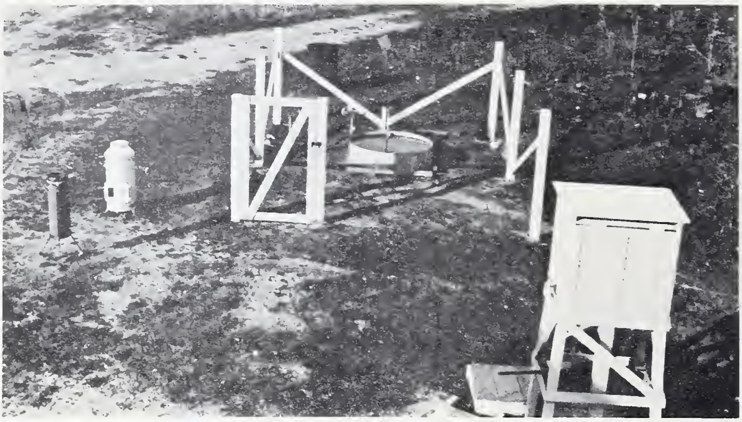
Sodic soils are difficult to reclaim, because they absorb water very slowly. To reclaim such soils, they must be saturated with water so that the excess sodium is leached from the soils and replaced by calcium.

Studies show that sodic soils can be reclaimed faster if the area is saturated with successive dilutions of high-salt water. In one study, each successive leaching used less sea water until the soil was leached of sodium salts and it would absorb water satisfactorily (hydraulic conductivity). Six successive leachings with sea water and Colorado River water were used to reclaim the sodic soil, with dilutions as shown in the chart.



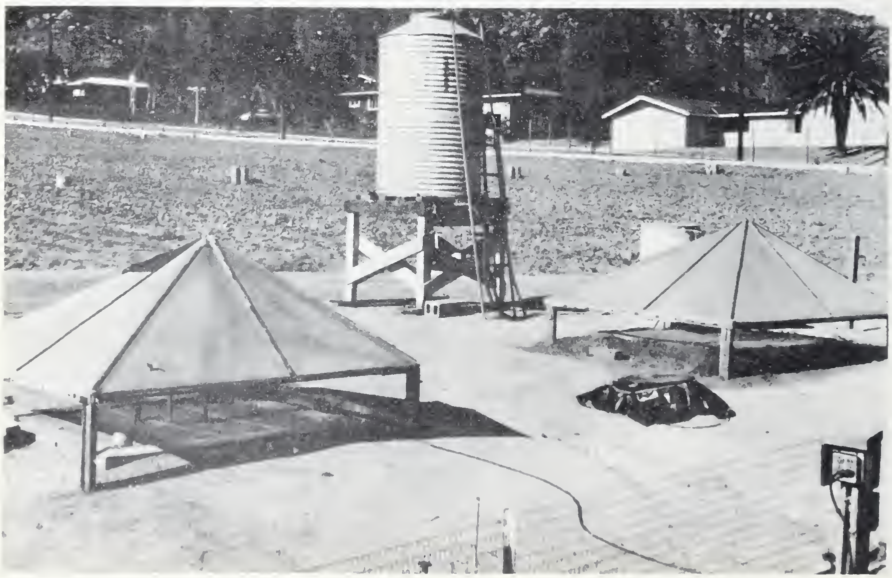
STUDIES OF EVAPORATION LOSSES

This Class A Weather Station shows the installations used for research studies concerned with losses of water by evapotranspiration from soil, water, and plant surfaces.



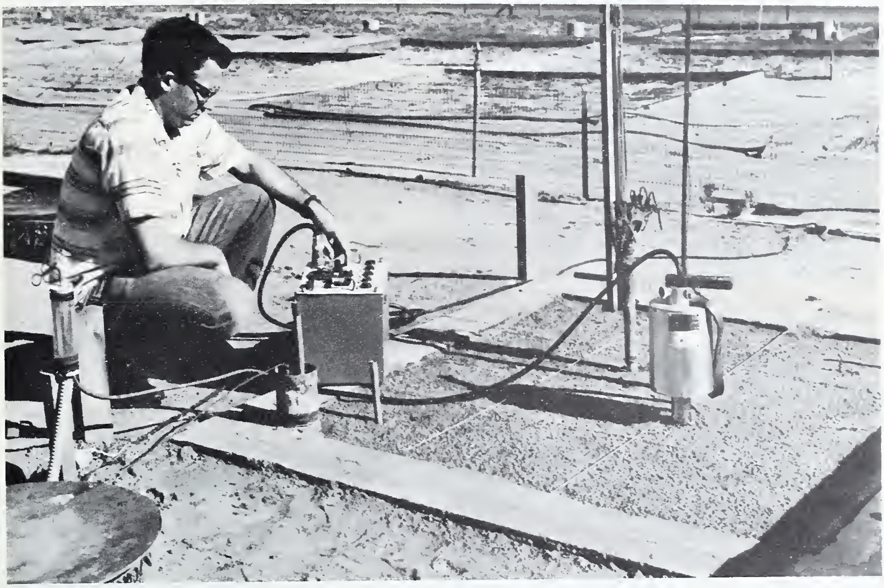
BN-15197

Evaporation studies measure losses of moisture from soils in the fields. These studies are essential to develop better methods of conserving water and soil resources. The soil-filled concrete tanks below are covered, so that only water supplied by the tank is used and can be measured as evaporation loss. The water is kept at a constant level. Riverside, Calif.



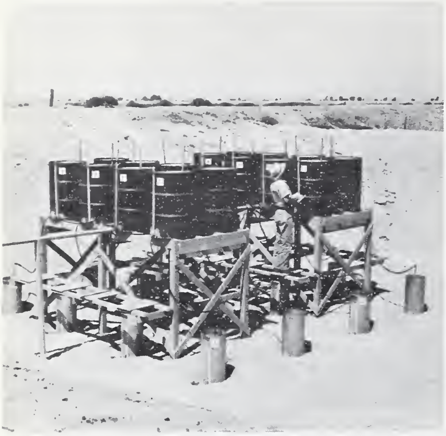
BN-15196

A technician measures the moisture content of the soil in the concrete tank with a neutron scaler. Although the water table is maintained at a constant level, the soil moisture may change, owing to atmospheric conditions. Evaporation from the soil surface is obtained by measuring the rate of inflow of water. Note the condition of the soil. The operator of the scaler (or recorder) is protected by the lead shielding atop the access tube, which had been installed previously in the center of the tank.



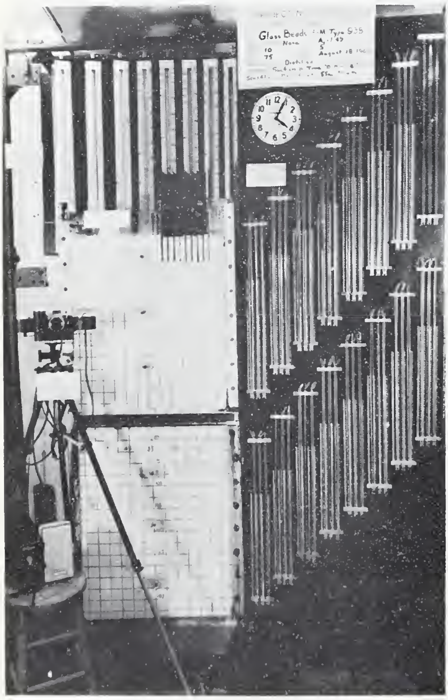
BN-15198

STUDIES OF WATER ENTERING THE SOIL



BN-15200

Cylinder infiltrometers are used to measure the rate and quantity of water that enter the soil. In this field near Bakersfield, Calif., the infiltrometers are equipped with manometers and connected to water supply tanks to test the effect of soil treatments on water entry into soils.

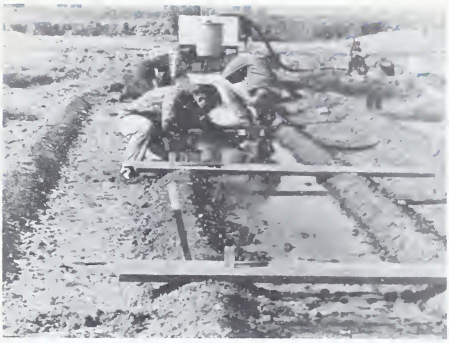


BN-15199

The hydraulics of cylinder infiltrometers is studied in a laboratory model at Davis, Calif. Such variables as cylinder diameter, use of multiple cylinders, hydraulic head, initial soil moisture content, temperature, operational procedures, and cylinder depth in soil are known to affect the rate and quantity of water entering the soil. These variables must be considered in conducting field tests with infiltrometers.

This laboratory model is 6 feet deep and has water supply tanks for individual cylinder compartments, separate manometers for a grid of 90 tensiometers installed in the soil profile for measuring moisture, and a time-lapse record camera.

By using radioactive gold in the irrigation water prior to its application, technicians can study the rate of water intake by the soil. They sample the water and soil at different points along the border. The quantity of radioactive gold in these samples is an index of the intake rate of water. This work is being carried on at Brawley, Calif.



BN-15202

Furrow irrigation systems are being studied in order to develop improved designs for new irrigation systems and to operate existing systems properly. In the illustration below, manometers have been installed at seven locations to provide readings of the water surface and to note elevation differences along the center furrow.

BN-15201

BN-15205

Sites for ground water storage reservoirs are being explored by the Division and the California State Department of Water Resources. Heavy drilling equipment is used at Fresno, Calif., to obtain soil cores and logs of deep strata and to install access tubes for measuring moisture with the neutron meter to depths of 100 feet or more.

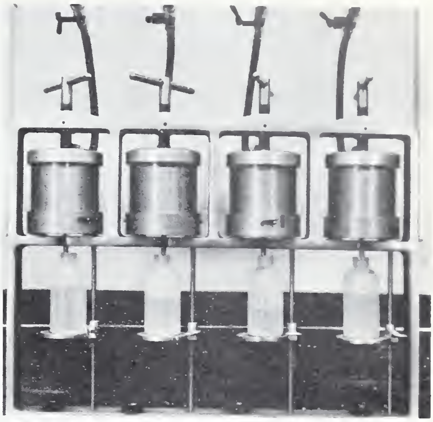
BN-15204

The soil cores obtained by the drilling machine are cut into sections and analyzed in the laboratory for their physical and chemical properties.

BN-15203

Quick freezing of soil cores helps to preserve the soil in its original state during storage. The freezing is done by using a mixture of alcohol and dry ice. The procedure permits sampling during favorable seasons and holding the cores in storage for later study at Pomona, Calif.

Moisture is extracted from soil samples with a pressure membrane at the Fresno laboratory. The extracts are analyzed for chemical constituents in order to determine the migration of these chemicals as a result of infiltration of the water.



BN-15208

BN-15207

Workers evaluate the physical properties and characteristics of the soil core samples in the laboratory. Here, moisture and soluble salt movements give information on ground water recharge potential of the experimental area represented by the soil core.

At the same time, chemists analyze the soil and extracts from the soil core.

BN-15206

PACIFIC COAST SOIL AND WATER RESOURCE REGION

Problem Areas in Soil Conservation

H1 - Western slope, Cascade Range

H2 - Puget Sound area

H3 - Olympic Mountains area

H4 - Coast Range and valleys, Oregon and Washington

H5 - Willamette Valley

H6 - Rosenburg-Grants Pass, Medford area

H7 - Klamath area

H8 - Northern California Coast Range

H9 - Northern California coastal redwood belt

H10 - Sierra Nevada Mountains

H11 - Sierra Nevada foothills

H12 - Sacramento-San Joaquin Valley

H13 - San Francisco Bay area

H14 - West-central California Coast Range

H15 - Eastern slope, Sierra Nevada Mountains

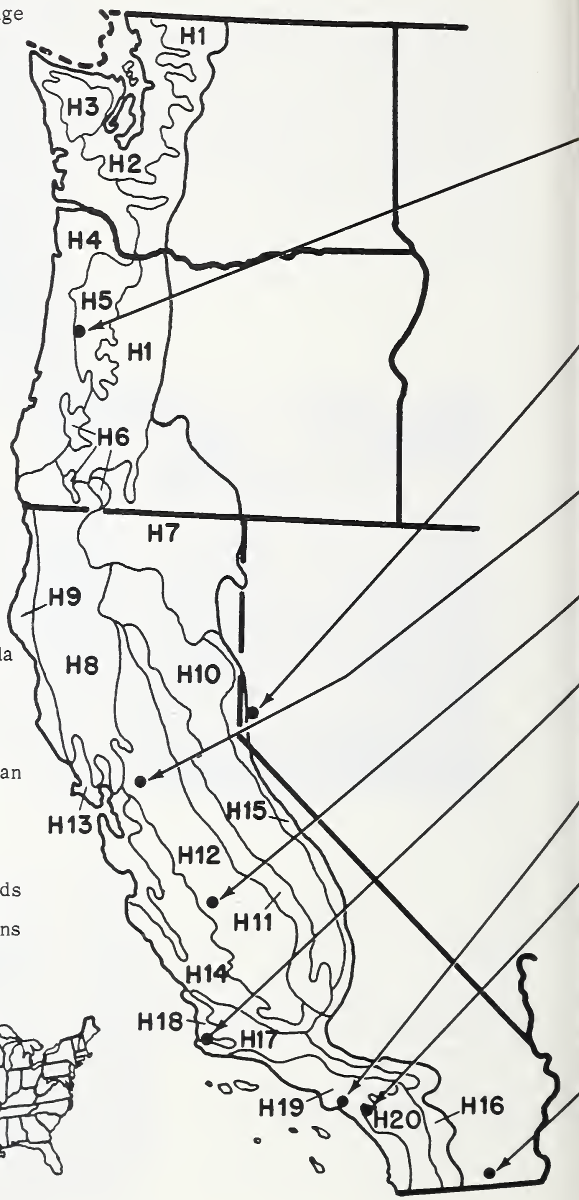
H16 - Eastern slope, southern California mountains

H17 - San Rafael, Sierra Madre, San Bernardino Mountains

H18 - Santa Barbara area

H19 - Southern California coastal plains and neighboring islands

H20 - Southern California mountains and valleys



VISIT OR CONTACT THESE LOCATIONS TO OBTAIN CURRENT INFORMATION AND TO OBSERVE RESEARCH IN ACTION ON PRIORITY PROBLEMS

OREGON

Corvallis: Agricultural Research Service office, Soils Department, Oregon State College
Work: Laboratory studies of organic matter in soils.

NEVADA

Reno: Agricultural Research Service office, Max C. Fleischman College of Agriculture Building, University of Nevada
Work: Water supply and consumptive use; drainage investigations; bentonites for canal sealing.

CALIFORNIA

Davis: Agricultural Research Service office, Irrigation Building, University of California
Work: Cylinder infiltrometer model studies.

Fresno: 4816 East Shields Avenue
Work: Recharge of water into storage underground.

Lompoc: 7th and Chestnut Streets
Work: Water supply and consumptive use under coastal climates.

Pomona: Post Office Building
Work: Drainage investigations; salinity and water use trends under irrigated crop production.

Riverside: U.S. Salinity Laboratory
Work: Saline and sodic soils and waters in relation to plant growth.

Agricultural Research Service office, Irrigation Building, University of California
Work: Moisture-fertilizer relationships; conservation practices for dry crop and range lands.

Brawley: Southwestern Irrigation Field Station
Work: Moisture-fertilizer relationships, irrigation practices, crop rotations, and drainage for irrigated lands.

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Problem Areas in Soil Conservation

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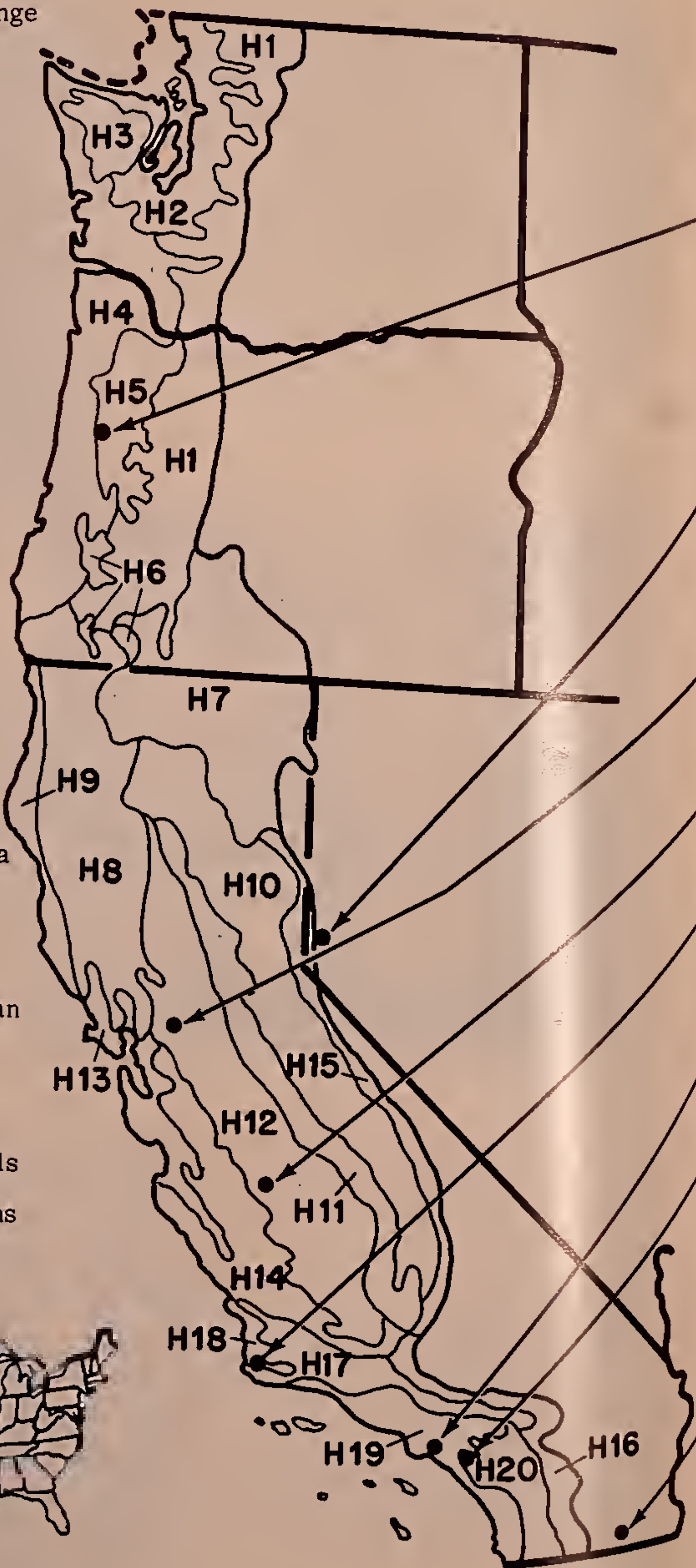

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BN-15212

Slowly permeable soils at Bakersfield, Calif., were excavated down to coarse sand strata that were highly permeable. Water from this pit then recharged underground reservoirs rapidly. Conventional surface application methods are not practicable on surface soils of low permeability.

BN-15211

Suspended silts and clays in recharge water often form crusts that clog surfaces of pits or trenches. Studies of crust removal by scraping or suction to restore infiltration are underway at Bakersfield.

BN-15210

In a study at Fresno, irrigation water is applied in excess to crops, for the purpose of recharging part of the water into underground reservoirs.

BN-15209

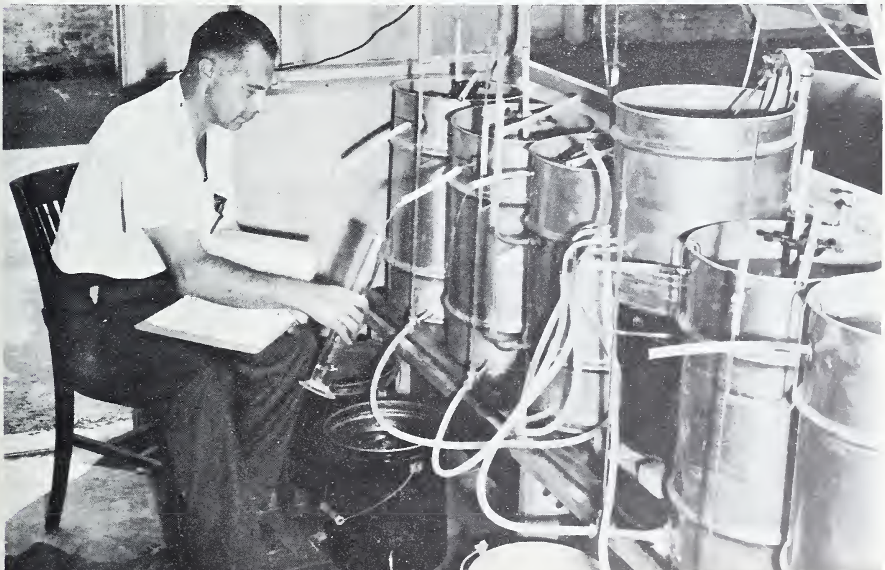
Here, tailwater is measured from a cottonfield receiving excess irrigation water for recharge purposes.

DEVELOPING NEW TECHNIQUES FOR DRAINAGE INVESTIGATIONS

A technician is measuring the amount of effluent in a farm drain ditch. Samples of the effluent are taken periodically for quality-of-water analyses. These data, together with records of depth to ground water and of changes in soil properties of adjacent fields after drainage, provide information for the development of better drainage systems.

BN-15214

Water is passed through the sand in the five steel drums below, and the rate of flow is determined. Then, 1/4-inch diameter well points are inserted in the sand, and hydraulic conductivity tests are made for comparative purposes. From these tests, a simplified well-point technique is being developed at Pomona, Calif., for in-place field measurement of hydraulic conductivity. The drainability of irrigated soils is related to the hydraulic conductivity.



BN-15213

BN-15216

This technician is measuring seepage from an irrigation ditch to determine the water loss. This is part of a study to determine if such losses contribute to the drainage problems in North Shore area of Carson Lake, Nev.

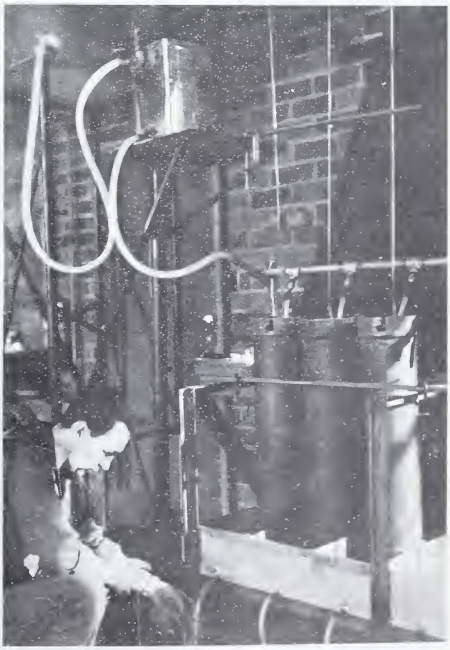
BN-15215

Bentonite clays are often used to seal linings of irrigation canals to prevent water loss. Laboratory cylinders containing suspensions of bentonite clays show varying flocculation or settling volumes. Note that some solutions above the settled clay are more turbid than others. This research shows that the varying quantities of sodium and calcium in bentonites cause variations in the properties of the dispersed bentonite clays. These variations influence the effectiveness of bentonite clays as sealants.

The superspeed centrifuge shown here is used to measure the swelling rate of bentonite suspensions. The volume of bentonite gel that settles during centrifugation (see residue in glass tube) is used as one indicator of the performance of the bentonite when used in sealing irrigation canals.

BN-15218

The three cylinders shown here are packed with sand and are being used to measure the reduction in flow of water when different kinds and quantities of bentonite clay are applied. The water is supplied from the tank at upper left. After the flow measurements are completed, the cylinders are opened to study the nature of the bentonite penetration into the sand columns. Information gained in such laboratory experiments is used for further tests with bentonites in farm canals and ditches.



BN-15217

REMOVING RESIDUES FROM TILE LINES

In the Imperial and Coachella Valleys of southern California, iron and manganese oxide deposits occur in tile lines, primarily at the joints, and cause serious malfunctioning of these installations. As a result of the deposits, water enters the tile system more slowly. Approximately 9,000 acres of tiled land in the Imperial Valley is known to be affected by these mineral deposits. An additional 50,000 acres is suspected as being affected by deposits of iron and manganese.

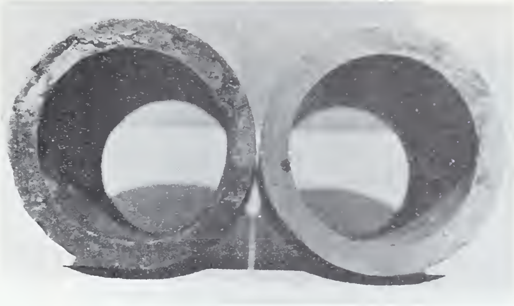
BN-15220

An 8-inch drain tile is approximately half-filled with residue as a result of accumulations of iron and manganese oxides at the outlet. These accumulations drastically reduce water movement in the tile.

In 1955 a chemical solution was developed to reduce the iron and manganese oxides accumulating the drain tile. In this treatment a solution of sodium bisulfite and sulfuric acid is added in the proper proportion to a riser (right in photograph) provided at the head of each lateral in the drain system. The flow of liquids in the four hoses are so regulated that the desired concentration of the chemicals are supplied to the system. The line is flooded by stoppering the outlet and filling the line with the solution. After 24 hours the lines are opened and flushed to remove the dissolved residue material.

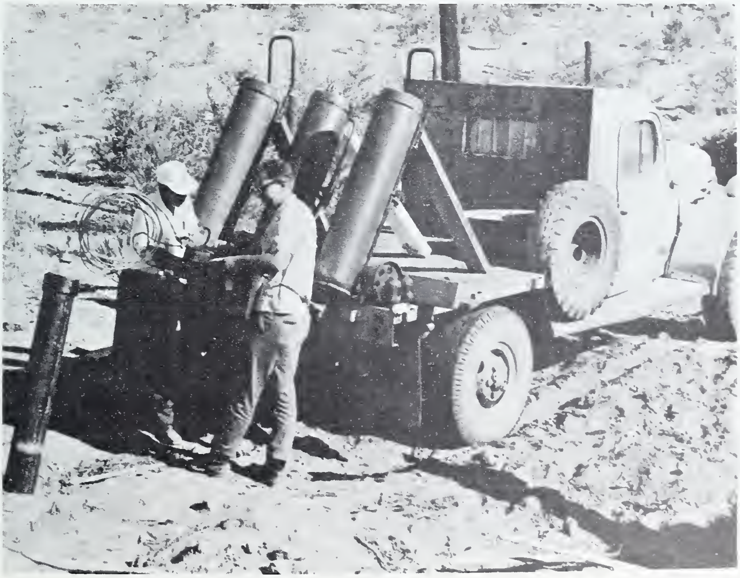
BN-15219

These drain tiles were dug up 4 years after the one on the right was flooded with a chemical solution to remove iron and manganese deposits. Note that the inner surface and joints are still clean, so that movement of water is not slowed. Treated systems have been operating effectively for 4 years without sufficient recurrence of oxides to decrease the efficiency.



BN-15222

In 1960, a simplified treatment was devised to dissolve the iron and manganese oxides. Liquified sulfur dioxide is injected directly from tanks into the head end (lower left in photo) of the tile system, where the chemical reacts with the oxides to dissolve them. The outlet of the tile line is plugged and the solution is maintained in the system for 24 hours. The cost of this new treatment is about the same as the solution technique devised in 1955, or $4 per acre. However, the new technique requires less labor and attention. In one instance, the effluent flow from one tile system increased approximately 100 percent after treatment, although no additional irrigation water was added to the field.

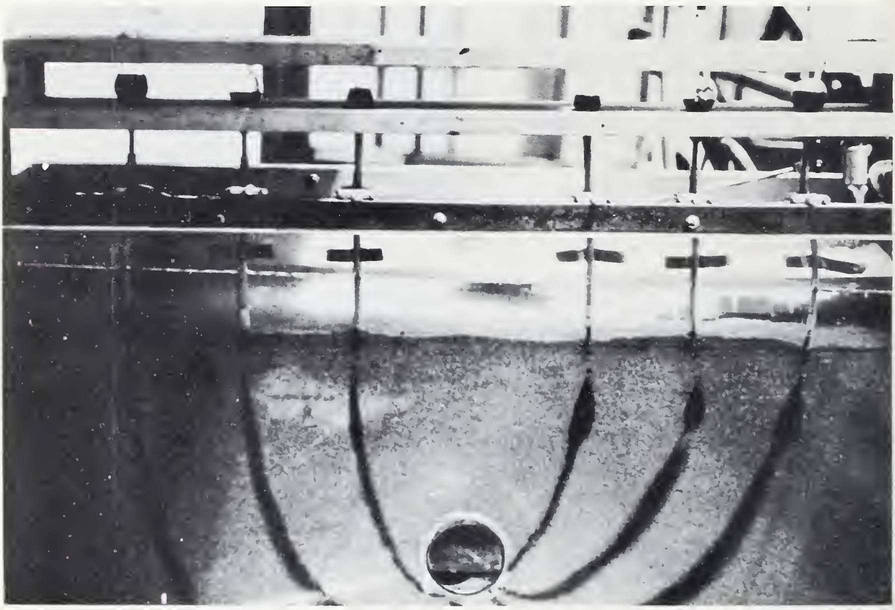


BN-15221

STUDIES OF PLASTIC-LINED MOLE-TYPE DRAINS

Eight field experiments to determine the efficiency and durability of plastic-lined mole drains are being conducted in the Southwestern States. The plastic liners give good results except on sandy soils, where the drains rapidly fill with sand and tend to collapse. Laboratory research is now underway to determine why the plastic-lined drains fail in sandy soils. One method that is being tested is the perforating of the plastic, to minimize entrance of sand particles.

In the laboratory test shown below, a 1-foot section of 3-inch diameter plastic-lined drain is installed in sand in a small tank at Pomona, Calif., to simulate field conditions. Water is ponded on the surface of the soil. Droplets of dye are applied below the surface in the saturated sand. The dye tracer pinpoints the direction and the location where the water enters the drain.



BN-15223

EVALUATING THE INFLUENCE OF WATER TABLES IN CROP PRODUCTION

The equipment measures fluctuations in water table depth during and after each irrigation in the North Shore Carson Lake area near Fallon, Nev. These measurements are a part of a study to determine to what extent over-irrigation is a cause of the drainage problem in the area.

BN-15225

At Reno, Nev., 63 constant water table lysimeters are used to study the effects of water table depths of 2, 4, and 6 feet on water use and yield of alfalfa. During the 2-year study, results showed that alfalfa uses more water if the water table is maintained at the shallow depths--2 to 4 feet. The lysimeter tanks are placed below ground in rows in the central area, and the tanks above ground at right and left supply the water for the lysimeters.

BN-15224

SUPPLYING ADEQUATE FERTILIZER NECESSARY FOR GOOD YIELDS

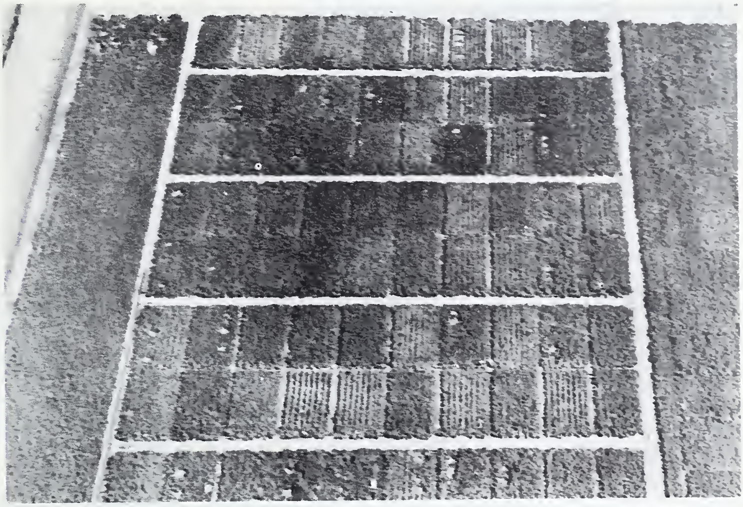
Barley growing on summer fallow land shows better growth and darker color where nitrogen fertilizer was applied. Phosphorus and sulfur fertilizers were applied also, but these fertilizers did not improve growth or yield. This experimental field is located in the San Jacinto Soil Conservation District near Hemet, Calif.

BN-15227

Volunteer barley on the right shows extremely vigorous growth from the application of 300 pounds 16-20-0 fertilizer per acre, as compared to the unfertilized area on left. The barley is used for grazing. The crop represents an excellent means for soil protection against erosion, efficient use of moisture, and high returns of forage for dryland areas in the San Jacinto Soil Conservation District.

BN-15226

Proper balance between water and nitrogen fertilizer produces high yields of cotton and minimizes lodging of the crop. This aerial photograph shows differences in growth of cotton on an experimental plot at Brawley, Calif., where combinations of six moisture levels and four nitrogen fertilizer rates were compared. Plots that are darker and do not show the rows received the higher nitrogen rates and adequate moisture.



BN-15229

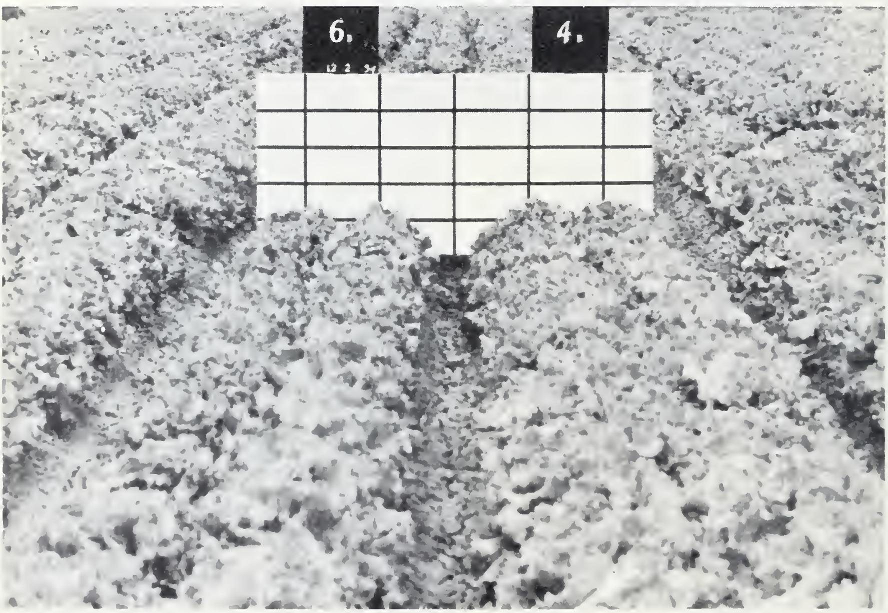
If too much nitrogen is applied as a side dressing in August, a vigorous late-season growth results in an excessively tall cotton plant that is susceptible to lodging (left). The plant at right received an equal amount of nitrogen, but all of it was applied before July 10. As a result of this research, it is recommended that all nitrogen fertilizer be applied early in the season.

BN-15228

BN-15231

Darker areas in this California vineyard show how nitrogen fertilizer promotes better growth of winter rye used as a cover crop. The rye protects the very sandy soils against wind erosion. Nitrogen is needed for the most efficient use of available moisture. This photograph was taken about 20 miles east of Riverside, Calif.

Phosphorus fertilizer improved the yield and quality of winter-grown lettuce in this field experiment at Brawley, Calif. The double row on the right received a preplant application of 120 pounds of P_2O_5 per acre and yielded 28 percent more cartons of lettuce per acre than the plots without added phosphorus on the left. Adequate nitrogen and water were applied to both plots. Added phosphorus also increased head size, hastened maturity, and promoted a more vigorous and uniform growth of lettuce.



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Growth Through Agricultural Progress